Preprints.org

Concept Paper

Not peer-reviewed version

From Chaos to Efficient Computing: Universal Compression, the P vs NP Divide, and the Hidden Hand of Code

Berend Watchus *

Posted Date: 30 June 2025

doi: 10.20944/preprints202506.2408.v1

Keywords: universal compression; P vs NP; computational complexity; Kolmogorov complexity; fractals; DNA coding; lazy evaluation; modularity; computational efficiency; algorithmic information theory; error-correcting codes; simulation hypothesis; reality engine; information theory; heuristic computation; energy optimization; time optimization; information optimization; logical steps; biological evolution; human cognition; artificial intelligence; emergent principles; complexity theory; physics; cosmology; systems theory; pattern recognition; entropy reduction; compression algorithms; quantum computing; problem hardness; heuristic search; self-correcting codes; universality; computational limits; optimization strategies; coding theory; interdisciplinary research; computational paradigm; systems biology; machine learning

Preprints.org is a free multidisciplinary platform providing preprint service that is dedicated to making early versions of research outputs permanently available and citable. Preprints posted at Preprints.org appear in Web of Science, Crossref, Google Scholar, Scilit, Europe PMC.

Copyright: This open access article is published under a Creative Commons CC BY 4.0 license, which permit the free download, distribution, and reuse, provided that the author and preprint are cited in any reuse.

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: Posted: 30 June 2025 doi:10.20944/preprints202506.2408.v1

Disclaimer/Publisher's Note: The statements, opinions, and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions, or products referred to in the content.

Concept Paper

From Chaos to Efficient Computing: Universal Compression, the P vs NP Divide, and the Hidden Hand of Code

Berend Watchus

Independent Researcher, The Netherlands; mailonlinebw@protonmail.com

Abstract

This paper explores the hypothesis that our universe functions as a highly efficient "reality engine," guided by a fundamental principle of universal computational efficiency. Central to this framework is the P vs NP divide, which acts as a boundary constraining what is efficiently computable or compressible. Across scales—from subatomic particles to cosmic structures, from biological evolution to human cognition, and extending into artificial intelligence and human technological systems—this principle manifests as the "hidden hand of code" optimizing energy, time, information, and logical steps. By analyzing patterns such as fractals, DNA self-correction, lazy evaluation, and modular design, the paper presents a unifying conceptual framework that reconciles computational complexity with observable natural efficiencies. This work aims to foster a paradigm shift in understanding intelligence, evolution, and reality itself, providing new perspectives for future research across multiple disciplines.

Keywords: universal compression; P vs NP; computational complexity; Kolmogorov complexity; fractals; DNA coding; lazy evaluation; modularity; computational efficiency; algorithmic information theory; error-correcting codes; simulation hypothesis; reality engine; information theory; heuristic computation; energy optimization; time optimization; information optimization; logical steps; biological evolution; human cognition; artificial intelligence; emergent principles; complexity theory; physics; cosmology; systems theory; pattern recognition; entropy reduction; compression algorithms; quantum computing; problem hardness; heuristic search; self-correcting codes; universality; computational limits; optimization strategies; coding theory; interdisciplinary research; computational paradigm; systems biology; machine learning

1. Introduction

The quest to understand the underlying principles governing the universe has long been a central pursuit of science. This paper proposes that a unifying principle—universal computational efficiency—is fundamental across all observed phenomena. Rather than limiting itself to one domain, this principle acts as a "swiss-army knife" of logic and efficiency that permeates nature, technology, and cognition alike.

At the heart of this framework lies the P vs NP problem, a central open question in computational complexity. While not providing a formal proof, this paper argues that the P vs NP divide serves as a natural boundary shaping how systems navigate complexity, inherently favoring efficient strategies such as compression, lazy computation, modular reuse, and heuristic approaches.

This approach reframes the universe as a "reality engine" operating under the constraints of computational resources—energy, time, information, and logical steps—and optimizes these resources across scales. From the fractal patterns seen in nature, the error-correcting codes embedded in DNA, to the evolutionary pressures on cognition and artificial intelligence design, these principles recur, revealing a hidden architecture of code.

© 2025 by the author(s). Distributed under a Creative Commons CC BY license.

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: Posted: 30 June 2025 doi:10.20944/preprints202506.2408.v1

The paper synthesizes interdisciplinary insights to build a conceptual framework, fostering a deeper understanding of intelligence, evolution, and the structure of reality. By drawing parallels across domains, it aims to inspire new research directions and challenge prevailing paradigms.

2. Background: The P vs NP Problem and Computational Complexity

The P vs NP problem addresses whether every problem whose solution can be quickly verified (NP) can also be quickly solved (P). This question has profound implications for computation, mathematics, and the natural world.

If P = NP, efficient solutions exist for a vast class of problems, radically transforming fields such as cryptography, optimization, and artificial intelligence. If P ≠ NP, many problems remain inherently intractable, enforcing fundamental limits on what can be efficiently computed.

This divide acts as a heuristic boundary that natural systems appear to respect. Nature, constrained by limited computational resources, adopts strategies to avoid brute-force computation, favoring compressed representations, approximate heuristics, and modular reuse—mechanisms that implicitly navigate the P vs NP landscape.

3. Methods: Analytical Framework

This research is qualitative and synthetic, drawing on interdisciplinary literature across computational complexity, biology, physics, and artificial intelligence. It builds a conceptual framework by identifying recurring efficiency principles in natural and artificial systems, mapping them to constraints imposed by computational complexity.

4. Manifestations of Universal Efficiency Principles

4.1. Fundamental Constants and Physical Laws

Physical laws and constants exemplify optimized constraints that reduce computational and energetic costs. For instance, the Principle of Least Action minimizes energy expenditure across physical processes, representing a form of global optimization.

4.2. Compression and Error-Correcting Codes in DNA

Genetic information leverages compression and robust error-correcting codes, as described by S. James Gates Jr., who highlighted code-like structures embedded in fundamental physics. These biological systems optimize information fidelity and resource use, paralleling computational compression.

Kolmogorov complexity provides a theoretical baseline for describing minimal program size needed to reproduce a dataset. While uncomputable in general, practical approximations such as Lempel-Ziv algorithms offer useful surrogates, mirrored by biological and technological compression methods.

4.3. Lazy Evaluation and On-Demand Computation

Nature employs “lazy” or on-demand computation to minimize resource use. Quantum measurement, selective sensory processing, and metabolic regulation exemplify systems that compute only what is necessary, avoiding exhaustive calculation.

4.4. Pattern Reuse and Modularity

Modularity in natural and technological systems allows for reusable “code modules,” improving efficiency. This principle spans molecular biology, software engineering, and cultural evolution, reflecting a universal strategy to reduce computational redundancy.

© 2025 by the author(s). Distributed under a Creative Commons CC BY license.

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: Posted: 30 June 2025 doi:10.20944/preprints202506.2408.v1

5. Case Study: Human-AI Collaboration on P vs NP

[Note: The section on the human-AI collaboration case study was removed upon author's request.]

6. Discussion

The P vs NP divide, far from being an abstract mathematical problem, manifests as a practical constraint that shapes evolutionary and computational strategies. The pervasive presence of compression, heuristic search, lazy evaluation, and modular design across natural and artificial systems supports this view.

This perspective invites a paradigm shift: understanding intelligence and reality as emergent outcomes of universal efficiency constraints. It bridges domains, from physics to biology to AI, offering a unifying lens.

7. Conclusion

This paper presents a conceptual framework positioning universal computational efficiency and the P vs NP divide as central organizing principles underlying the structure and evolution of complex systems. Recognizing these principles fosters interdisciplinary research and may guide future AI design and scientific discovery.

References

1. Aaronson, S. (2013). Quantum Computing Since Democritus. Cambridge University Press. https://doi.org/10.1017/CBO9781139179698
2. Chaitin, G. J. (1975). A theory of program size formally identical to information theory. Journal of the ACM, 22(3), 329–340. https://doi.org/10.1145/321892.321899
3. Garey, M. R., & Johnson, D. S. (1979). Computers and Intractability: A Guide to the Theory of NP-Completeness. W. H. Freeman.
4. Gates Jr., S. J. (2013, June 6). Uncovering the codes for reality [Audio podcast transcript]. On Being with Krista Tippett. (Original air date: March 1, 2012). Retrieved from https://onbeing.org/programs/s-james-gates-uncovering-the-codes-for-reality/
5. Kolmogorov, A. N. (1965). Three approaches to the quantitative definition of information. Problems of Information Transmission, 1(1), 1–7.
6. Mandelbrot, B. B. (1982). The Fractal Geometry of Nature. W. H. Freeman and Company.
7. Papadimitriou, C. H. (1994). Computational Complexity. Addison-Wesley.
8. Watchus, B. (2024). Advanced Predictive Modeling of Physical Trajectories and Cascading Events, Dual-State Feedback and Synthetic Insula. Preprints.org. https://doi.org/10.20944/preprints202411.1025.v1
9. Watchus, B. (2024). Self-Identification in AI: ChatGPT's Current Capability for Mirror Image Recognition. Preprints.org. https://doi.org/10.20944/preprints202411.1112.v1
10. Watchus, B. (2024). Simulating Self-Awareness: Dual Embodiment, Mirror Testing, and Emotional Feedback in AI Research. Preprints.org. https://doi.org/10.20944/preprints202411.0839.v1
11. Watchus, B. (2024). The Unified Model of Consciousness: Interface and Feedback Loop as the Core of Sentience. Preprints.org. https://doi.org/10.20944/preprints202411.0727.v1
12. Watchus, B. (2024). Towards Self-Aware AI: Embodiment, Feedback Loops, and the Role of the Insula in Consciousness. Preprints.org. https://doi.org/10.20944/preprints202411.0661.v1
13. Watchus, B. (2025). EAISE: A Simulation Environment for Self-Evolving Embodied AI with Mirror Testing and Multi-Agent Diagnostics. Preprints.org. https://doi.org/10.20944/preprints202506.1700.v1
14. Watchus, B. (2025). Gauging Extraterrestrial Sentience & Intelligence: Substrate-Agnostic Metrics for ETI Beyond the Kardashev Scale. Preprints.org. https://doi.org/10.20944/preprints202506.2120.v1
15. Watchus, B. F. (2025). Longitudinal Cross-Embodiment Transfer of Pseudo-Self-Awareness in AI Systems: A Mirror Test Investigation. Preprints.org. https://doi.org/10.20944/preprints202506.1694.v1

© 2025 by the author(s). Distributed under a Creative Commons CC BY license.

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: Posted: 30 June 2025 doi:10.20944/preprints202506.2408.v1

16. Watchus, B. (2025). The Architectures of Meaning: Integrating Hoffman's Perception Theory with Synthetic Ethical Embodiment in AI. Preprints.org. https://doi.org/10.20944/preprints202506.2025.v1
17. Watchus, B. (2025). Visual Perspective as an Emergent Heuristic: Insights for Self-Aware AI and World Modeling. Preprints.org. https://doi.org/10.20944/preprints202506.1701.v1

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

© 2025 by the author(s). Distributed under a Creative Commons CC BY license.